Rule 5. Non-Medical Radiography

410 IAC 5-5-1 Scope of rule

Sec. 1. The requirements in 410 IAC 5-5 establish radiation safety requirements for persons utilizing sources of radiation for non-medical radiography (i.e., industrial radiography, ionizing radiation gauging devices, NARM, and any other non-medical use). The requirements of 410 IAC 5-5 are in addition to, and not in substitution for, the other requirements of 410 IAC 5.

410 IAC 5-5-2 Applicability of rule

Sec. 2. The requirements in 410 IAC 5-5 apply to all registrants who use sources of radiation for non-medical radiography. Except for those requirements of 410 IAC 5-5 clearly applicable only to sealed radioactive sources, both radiation machines and sealed radioactive sources are covered by 410 IAC 5-5.

410 IAC 5-5-3 Definitions

Sec. 3. As used in 410 IAC 5-5, the following definitions apply:

"ANSI" means the American National Standards Institute.

"Enclosed radiography" means industrial radiography conducted in an enclosed cabinet or room and includes cabinet radiography and shielded room radiography.

(1) "Cabinet radiography" means industrial radiography conducted in an enclosure or cabinet so shielded that every location on the exterior meets the limitations specified in 410 IAC 5-4-6.

(i) "Cabinet x-ray system" means an x-ray system with the x-ray tube installed in an enclosure (hereinafter termed "cabinet") which, independent of existing architectural structures except the floor on which it may be placed, is intended to contain at least that portion of a material being irradiated, provide radiation attenuation, and exclude personnel from its interior during generation of x-radiation. Included are all x-ray systems designed primarily for the inspection of carry-on baggage at airlines, railroads, bus terminals, and in similar facilities. An x-ray tube used within a shielded part of a building, or x-ray equipment which may temporarily or occasionally incorporate portable shielding is not considered a cabinet x-ray system.

(ii) "Certified cabinet x-ray system" means an x-ray system which has been certified in accordance with 21 CFR 1010.2 as being manufactured and assembled pursuant to the provisions of 21 CFR 1020.40.

(2) "Shielded-room radiography" means industrial radiography conducted in a room so shielded that radiation levels at every location on the exterior meet the limitations specified in 410 IAC 5-4-6.

"Gamma radiography" means industrial radiography using radioactive material that emits gamma rays (i.e., Ir 192, Co 60, Cs 137).

"Industrial radiography" means the use of penetrating radiation, such as x-rays, gamma rays, or neutrons, to make pictures of the insides of objects (i.e., metal castings or welds).

"Ionizing radiation gauging device" (gauge) means a mechanism designed and manufactured for the purpose of determining or controlling thickness, density, level, interface location, or qualitative or quantitative chemical composition.

"NARM" means any naturally occurring or accelerator produced radioactive material. It does not include by-product, source, or special nuclear material.

"Permanent radiographic installation" means an installation or structure designed or intended for radiography and in which radiography is regularly performed.

"Personal supervision" means supervision such that the supervisor is physically present at the site where sources of radiation and associated equipment are being used, watching the performance of the radiographer's assistant and in such proximity that contact can be maintained and immediate assistance given as required.

"Radiographer" means any individual who performs or provides personal supervision of industrial radiographic operations and who is responsible to the licensee or registrant for assuring compliance with the requirements of 410 IAC 5 and all license (and/or registration) conditions.

"Radiographer's assistant" means any individual who, under the personal supervision of a radiographer, uses sources of radiation, related handling tools, or radiation survey instruments in industrial radiography.

"Radiographic exposure device" means any instrument containing a sealed source fastened or contained therein, in which the sealed source or shielding thereof may be moved, or otherwise changed, from a shielded to unshielded position for purposes of making a radiographic exposure.

"Shielded position" means the location within the radiographic exposure device or storage container which, by manufacturer's design, is the proper location for storage of the sealed source.

"Source changer" means a device designed and used for replacement of sealed sources in radiographic exposure devices, including those source changers also used for transporting and storage of sealed sources.

"Storage container" means a device in which sealed sources are transported or stored.

"Temporary job site" means any location where industrial radiography is performed other than the location(s) listed in a specific license or certificate of registration.

410 IAC 5-5-3.1 Additional requirements; safety programs

Sec. 3.1. (a) Ionizing radiation gauging devices shall comply with applicable sections of ANSI N538 or its equivalent, in addition to 410 IAC 5-5-8 and other applicable sections of 410 IAC 5.

(b) The board may impose any additional requirement for the specific application of an ionizing radiation source to protect the health and safety of an employee and/or the public. The board shall weigh the impact of any such requirement against the hazards created without such a requirement, before imposing any additional requirements.

(c) All non-medical users of "NARM" and/or devices that produce x-rays either as part of their design or incidental to other design functions shall have an adequate radiation safety program.

(1) The adequacy of the program will be evaluated by the board.

(2) The program must meet the intent of 410 IAC 5.

(3) The program shall keep personnel exposure ALARA (as low as reasonably achievable).

(4) The program shall take under consideration the education and training of the personnel utilizing or in the environs of the radiation device.

410 IAC 5-5-3.2 Enclosed radiography; special provisions and exemptions

Sec. 3.2. (a) Systems for enclosed radiography designed to allow admittance of individuals shall:

(1) Comply with 410 IAC 5-5-11, 410 IAC 5-5-11.5, 410 IAC 5-5-12, 410 IAC 5-5-13, 410 IAC 5-5-15, 410 IAC 5-5-16, and 410 IAC 5-5-18 of 410 IAC 5-5 and 410 IAC 5-4-6.

(2) Operating personnel must be provided with either a film badge or a thermoluminescent dosimeter and reports of the results must be maintained for inspection by the board.

(3) Be evaluated at intervals not to exceed 1 year to assure compliance with the applicable requirements as specified in 410 IAC 5-5-3.2(a)(1). Records of these evaluations shall be maintained for inspection by the board for a period of 2 years after the evaluation.

(b) Cabinet x-ray systems designed to exclude individuals are exempt from the requirements of 410 IAC 5-5-3.2 except that:

(1) No registrant shall permit any individual to operate a cabinet x-ray system until such individual has received a copy of instructions in the operating procedures for the unit and has demonstrated competence in its use. Records which demonstrate compliance with this subdivision shall be maintained for inspection by the board until disposition is authorized by the board;

(2) Tests for proper operation of high radiation area control devices or alarm systems, where applicable, must be conducted and recorded in accordance with 410 IAC 5-5-11.5; and

(3) The registrant shall perform or have done an evaluation, at intervals not to exceed 1 year, to determine conformance with 410 IAC 5-4-6. If such a system is a certified cabinet x-ray system, it shall be evaluated at intervals not to exceed 1 year to determine conformance with 21 CFR 1020.40. Records of these evaluations shall be maintained for inspection by the board for a period of 2 years after the evaluation.

(c) Certified cabinet x-ray systems shall be maintained in compliance with 21 CFR 1020.40 unless prior approval has been granted by the board pursuant to 410 IAC 5-1-3(a).

410 IAC 5-5-4 Radiation limits for exposure devices and storage containers for gamma radiography

Sec. 4. Radiographic exposure devices measuring less than 10 cm from the sealed source storage position to any exterior surface of the device shall have no radiation level in excess of 50 milliroentgens per hour at 15 cm from any exterior surface of the device. Radiographic exposure devices measuring a minimum of 10 cm from the sealed source storage position to any exterior surface of the device, and all storage containers for sealed sources or outer containers for radiographic exposure devices, shall have no radiation level in excess of 200 milliroentgens per hour at any exterior surface, and 10 milliroentgens per hour at 1 meter from any exterior surface. The radiation levels specified are with the sealed source in the shielded (i.e., "off") position.

410 IAC 5-5-5 Locking of sources for gamma radiography

Sec. 5. (a) Each source of radiation shall be provided with a lock or lockable outer container designed to prevent

unauthorized or accidental production of radiation or removal or exposure of a sealed source and shall be kept locked at all times except when under the direct surveillance of a radiographer or radiographer's assistant, or as may be otherwise authorized pursuant to 410 IAC 5-5-15. Each storage container and source changer likewise shall be provided with a lock and shall be kept locked when containing sealed sources except when the container is under the direct surveillance of a radiographer or radiographer's assistant.

(b) Radiographic exposure devices, source changers, and storage containers, prior to being moved from one location to another and also prior to being secured at a given location, shall be locked and surveyed to assure that the sealed source is in the shielded position.

410 IAC 5-5-6 Security precautions for gamma radiography

Sec. 6. Locked radiographic exposure devices, source changers, and storage containers shall be physically secured to prevent tampering or removal by unauthorized personnel.

410 IAC 5-5-7 Survey instruments for gamma and temporary job site radiography

Sec. 7. (a) The licensee or registrant shall maintain sufficient calibrated and operable radiation survey instruments to make physical radiation surveys as required by 410 IAC 5-5-7 and 410 IAC 5-4-9 of 410 IAC 5. Instrumentation required by this section shall have such a range such that 2 milliroentgens per hour through 1 roentgen per hour can be measured.

(b) Each radiation survey instrument shall be calibrated:

(1) at energies appropriate for use and at intervals not to exceed 3 months and after each instrument servicing;

(2) such that accuracy within plus or minus 20 percent traceable to a national standard can be demonstrated; and

(3) at two or more widely separated points, other than zero, on each scale.

(c) Records of these calibrations shall be maintained for two years after the calibration date for inspection by the board.

410 IAC 5-5-8 Leak testing, replacement, and modification of NARM sealed sources

Sec. 8. (a) The replacement of any "NARM" sealed source fastened to or contained in a radiographic exposure device and leak testing, repair, tagging, opening or any other modification of any sealed source shall be performed only by persons qualified by education and training.

(b) Each sealed source shall be tested for leakage at intervals not to exceed 6 months. In the absence of a certificate from a transferor that a test has been made within the 6 month period prior to the transfer, the sealed source shall not be put into use until tested.

(1) The board may grant exceptions to the leak test requirement for "NARM," when;

(i) The construction and history of a type of sealed source warrants a less frequent testing.

(ii) Access to the source places an undue burden on the registrant.

(2) Any "NARM" sealed source less than 100 times the quantity listed in Schedule B of 410 IAC 5-4 is excepted from leak tests.

(3) Any sealed source with a half-life less than 30 days and/or in gaseous form is excepted from leak tests.

(4) Any "NARM" sealed source $10^{ì}$ Ci or less used as a check source is excepted.

(c) The leak test shall be capable of detecting the presence of 0.005 microcurie of removable contamination on the sealed source. An acceptable leak test for sealed sources in the possession of a radiography licensee would be to test at the nearest accessible point to the sealed source storage position, or other appropriate measuring point. Records of leak test results shall be kept in units of microcuries and maintained for inspection by the board for 6 months after the next required leak test is performed or until the sealed source is transferred or disposed of.

(d) Any test conducted pursuant to 410 IAC 5-5-8(b) and (c) which reveals the presence of 0.005 microcurie or more of removable radioactive material shall be considered evidence that the sealed source is leaking. The licensee shall immediately withdraw the equipment involved from use and shall cause it to be decontaminated and repaired or to be disposed of, in accordance with rules of the board. Within 5 days after obtaining results of the test, the licensee shall file a report with the board describing the equipment involved, the test results, and the corrective action taken.

(e) A sealed source which is not fastened to or contained in a radiographic exposure device shall have permanently attached to it a durable tag bearing the prescribed radiation caution symbol in conventional colors, magenta or purple on a yellow background, and at least the instructions: "Danger Radioactive Material."

410 IAC 5-5-9 Quarterly inventory of sealed sources for gamma radiography

Sec. 9. Each licensee shall conduct a quarterly physical inventory to account for all sealed sources received or possessed by

him. The records of the inventories shall be maintained for 2 years from the date of the inventory for inspection by the board and shall include the quantities and kinds of radioactive material, the location of sealed sources, and the date of the inventory.

410 IAC 5-5-10 Utilization logs in gamma radiography

Sec. 10. Each licensee or registrant shall maintain current logs, which shall be kept available for inspection by the board for 2 years from the date of the recorded event showing for each source of radiation the following information:

(a) A description (or make and model number) of each source of radiation or storage container in which the sealed source is located;

(b) The identity of the radiographer to whom assigned; and

(c) Locations where used and dates of use.

410 IAC 5-5-11 Inspection and maintenance of industrial exposure devices and storage containers

Sec. 11. (a) Each licensee or registrant shall ensure that checks for obvious defects in radiation machines, radiographic exposure devices, storage containers, and source changers are performed prior to each day of use.

(b) The licensee or registrant shall conduct a program of at least quarterly inspection and maintenance of radiation machines, radiographic exposure devices, storage containers, and source changers to assure proper functioning of components important to safety. All appropriate parts shall be maintained in accordance with manufacturers' specifications. Records of inspection and maintenance shall be maintained for inspection by the board until it authorizes their disposal.

(c) If any inspection conducted pursuant to 410 IAC 5-5-11(a) or (b) reveals damage to components critical to radiation safety, the device shall be removed from service until repairs have been made.

410 IAC 5-5-11.5 Permanent installations

Sec. 11.5. Permanent radiographic installations having high radiation area entrance controls of the type described in 410 IAC 5-4-11(c)(2)(ii) and (iii) and (c)(4) shall also meet the following requirements:

(a) Each entrance that is used for personnel access to the high radiation area shall have both visible and audible warning signals to warn of the presence of radiation. The visible signal shall be activated by radiation. The audible signal shall be activated when an attempt is made to enter the installation while the source is exposed.

(b) The control device or alarm system shall be tested for proper operation at the beginning of each period of use. Records of these tests shall be maintained for inspection by the board until their disposal is authorized.

410 IAC 5-5-12 Personnel training and testing; internal audit of operating and emergency procedures

Sec. 12. Training and testing (applies to all industrial radiography). (a) No licensee or registrant shall permit any individual to act as a radiographer, as defined in 410 IAC 5-5-12, until such individual:

(1) Has been instructed in the subjects outlined in 410 IAC 5-5-20 and shall have demonstrated understanding thereof;

(2) Has received copies of and instruction in the requirements contained in this section and the applicable sections of 410 IAC 5-4 and 410 IAC 5-10, appropriate license(s), and the licensee's or registrant's operating and emergency procedures, and shall have demonstrated understanding thereof;

(3) Has demonstrated competence to use the source of radiation, radiographic exposure devices, related handling tools, and radiation survey instruments which will be employed in his assignment; and

(4) Has demonstrated an understanding of the instructions of 410 IAC 5-5-12(a) by successful completion of a written test and a field examination on the subjects covered.

(b) No licensee or registrant shall permit any individual to act as a radiographer's assistant as defined in 410 IAC 5-5-12 until such individual:

(1) Has received copies of and instruction in the licensee's or registrant's operating and emergency procedures, and shall have demonstrated understanding thereof;

(2) Has demonstrated competence to use, under the personal supervision of the radiographer, the sources of radiation, radiographic exposure device(s), related handling tools, and radiation survey instruments which will be employed in his assignment; and

(3) Has demonstrated an understanding of the instructions in 410 IAC 5-5-12(b) by successful completion of a written or oral test and a field examination on the subjects covered.

(c) Records of the above training, including copies of written tests and dates of oral tests and field examinations, shall be maintained for inspection by the board for 3 years following termination of employment.

(d) Each licensee or registrant shall conduct an internal audit program to ensure that the board's radioactive material license conditions and the licensee's or registrant's operating and emergency procedures are followed by each radiographer and

radiographer's assistant. These internal audits shall be performed at least quarterly, and each radiographer shall be audited at least annually. Records of internal audits shall be maintained for inspection by the board for 2 years from the date of the audit.

410 IAC 5-5-13 Operating and emergency instructions

Sec. 13. The licensee's or registrant's operating and emergency procedures shall include instructions in at least the following:

(a) The handling and use of sources of radiation to be employed such that no individual is likely to be exposed to radiation doses in excess of the limits established in 410 IAC 5-4;

(b) Methods and occasions for conducting radiation surveys;

(c) Methods for controlling access to radiographic areas;

(d) Methods and occasions for locking and securing sources of radiation;

(e) Personnel monitoring and the use of personnel monitoring equipment including steps that must be taken immediately by radiography personnel in the event a pocket dosimeter is found to be off-scale;

(f) Transportation to field locations, including packing of sources of radiation in the vehicles, posting of vehicles, and control of sources of radiation during transportation;

(g) Minimizing exposure of individuals in the event of an accident;

(h) The procedure for notifying proper personnel in the event of an accident;

(i) Maintenance of records; and

(j) The inspection and maintenance of radiographic exposure devices, source changers, storage containers, and radiation machines.

410 IAC 5-5-14 Personnel monitoring in gamma radiography

Sec. 14. (a) No licensee or registrant shall permit any individual to act as a radiographer or as a radiographer's assistant unless, at all times during radiographic operations, each such individual shall wear a direct reading pocket dosimeter and either film badge or a thermoluminescent dosimeter. Pocket dosimeters shall have a range from zero to at least 200 milliroentgens and shall be recharged daily or at the start of each shift. Each film badge or thermoluminescent dosimeter shall be assigned to and worn by only one individual.

(b) Pocket dosimeters shall be read and exposures recorded daily. An individual's film badge or thermoluminescent dosimeter shall be immediately processed if his pocket dosimeter is discharged beyond its range. Reports received from the film badge or thermoluminescent dosimeter processor and records of pocket dosimeter readings shall be maintained for inspection by the board until it authorizes their disposal.

(c) Pocket dosimeters shall be checked for correct response to radiation at periods not to exceed one year. Acceptable dosimeters shall read within plus or minus 30 percent of the true radiation exposure.

410 IAC 5-5-14.5 Supervision of radiographer assistants in gamma radiography

Sec. 14.5. Whenever a radiographer's assistant uses radiographic exposure devices, sealed sources, or related source handling tools, or conducts radiation surveys required by 410 IAC 5-5-17(b) and (c) to determine that the sealed source has returned to the shielded position after an exposure, the radiographer's assistant shall be under the personal supervision of a radiographer.

410 IAC 5-5-15 Security during operation

Sec. 15. During each radiographic operation, the radiographer or radiographer's assistant shall maintain a direct surveillance of the operation to protect against unauthorized entry into a high radiation area, as defined in 410 IAC 5-1, except:

(a) Where the high radiation area is equipped with a control device or alarm system as described in 410 IAC 5-4-11(c)(2), or

(b) Where the high radiation area is locked to protect against unauthorized or accidental entry.

410 IAC 5-5-16 Posting of operation areas

Sec. 16. Notwithstanding any provisions in 410 IAC 5-4-12(c), areas in which radiography is being performed shall be conspicuously posted as required by 410 IAC 5-4-11(b) and (c)(1).

410 IAC 5-5-17 Surveys; records

Sec. 17. (a) No radiographic operation shall be conducted unless calibrated and operable radiation survey instrumentation as

described in 410 IAC 5-5-9 is available and used at each site where radiographic exposures are made.

(b) A physical radiation survey shall be made after each radiographic exposure utilizing radiographic exposure devices or sealed sources of radioactive material to determine that the sealed source has been returned to its shielded position. The entire circumference of the radiographic exposure device shall be surveyed. If the radiographic exposure device has a source guide tube, the survey shall also include the guide tube.

(c) A physical radiation survey shall be made to determine that each sealed source is in its shielded position prior to securing the radiographic exposure device or storage container as specified in 410 IAC 5-5-5.

(d) A physical radiation survey shall be made after each radiographic exposure using radiation machines to determine that the machine is "off."

(e) Records shall be kept of the surveys required by 410 IAC 5-5-17(c). Such records shall be maintained for inspection by the board for 2 years after completion of the survey. If the survey was used to determine an individual's exposure, however, the records of the survey shall be maintained until the board authorizes their disposition.

410 IAC 5-5-18 Temporary job site records

Sec. 18. Each licensee or registrant conducting industrial radiography at a temporary site shall have the following records available at that site for inspection by the board:

(a) Appropriate license, (or certificate of registration) or equivalent document;

(b) Operating and emergency procedures;

(c) Applicable rules;

(d) Survey records required pursuant to 410 IAC 5-5-17 for the period of operation at the site;

(e) Daily pocket dosimeter records for the period of operation at the site; and

(f) The latest instrument calibration and leak test record for specific devices in use at the site. Acceptable records include tags or labels which are affixed to the device or survey meter.

410 IAC 5-5-20 Instruction of radiographers; scope

Sec. 20. Subjects to be Covered During the Instruction of Radiographers

(I) Fundamentals of Radiation Safety

(A) Characteristics of radiation

(B) Units of radiation dose (mrem) and quantity of radioactivity (curie)

(C) Significance of radiation dose

(1) Radiation protection standards

(2) Biological effects of radiation

(D) Levels of radiation from sources of radiation

(E) Methods of controlling radiation dose

(1) Working time

(2) Working distances

(3) Shielding

(II) Radiation Detection Instrumentation to be Used

(A) Use of radiation survey instruments

(1) Operation

(2) Calibration

(3) Limitations

(B) Survey techniques

(C) Use of personnel monitoring equipment

(1) Film badges

(2) Thermoluminescent dosimeters

(3) Pocket dosimeters

(III) Radiographic Equipment to be Used

(A) Remote handling equipment

(B) Radiographic exposure devices and sealed sources

(C) Storage containers

(D) Operation and control of x-ray equipment

(IV) The Requirements of Pertinent Federal and State Rules

(V) The Licensee's or Registrant's Written Operating and Emergency Procedures

(VI) Case Histories of Radiography Accidents